

SECTION 25.114 (d) TECHNICAL INFORMATION

SECTION 25.114 (d) INFORMATION FOR AMAZONAS-1 SPACE STATION

(1) General description of overall system facilities, operations and services;

AMAZONAS-1 will be used to satisfy the needs of communications by satellite in Europe and in the Americas.

HISPASAT will operate AMAZONAS-1 satellite system at 36° W.L. to provide a wide range of telecommunications services, including routing and DTH delivery of video and audio programs, satellite news gathering, VSAT applications, internet backbone services, broadband links, multimedia and interactive services, capacity for both public and private networks, etc.

(2) If applicable, the feeder link and inter-satellite service frequencies requested for the satellite, together with any demonstration otherwise required by this chapter for use of those frequencies (see, e.g., §§25.203(j) and (k));

N/A

(3) Predicted space station antenna gain contour(s) for each transmit and each receive antenna beam and nominal orbital location requested. These contour(s) should be plotted on an area map at 2 dB intervals down to 10 dB below the peak value of the parameter and at 5 dB intervals between 10 dB and 20 dB below the peak values, with the peak value and sense of polarization clearly specified on each plotted contour. For applications for geostationary orbit satellites, this information must be provided in the .gxt format.

The station antenna gain contour in copolar and crosspolar for the NORTH AMERICA beam are contained electronically in .gxt format in the files named:

- *vupkunach.GXT (NORTH AMERICA receive beam horizontal polarization, copolar),*
- *VUPKUNAXh.GXT (NORTH AMERICA receive beam horizontal polarization, crosspolar),*
- *vupkunacv.GXT (NORTH AMERICA receive beam vertical polarization, copolar),*
- *VUPKUNAXv.GXT (NORTH AMERICA receive beam vertical polarization, crosspolar),*
- *vdwkunach.GXT (NORTH AMERICA transmit beam horizontal polarization, copolar),*
- *VDWKUNAXh.GXT (NORTH AMERICA transmit beam horizontal polarization, crosspolar),*
- *vdwkunacv.GXT (NORTH AMERICA transmit beam vertical polarization, copolar) and*
- *VDWKUNAXv.GXT (NORTH AMERICA transmit beam vertical polarization, crosspolar)*

attached to this application.

For the NORTH AMERICA beam, the gain peak for receiving antenna is 31 dBi and for the transmitting antenna 29.9 dBi, for both polarizations.

Annex-1 contains the copolar and crosspolar antenna gain contours for the NORTH AMERICA beam.

- (4) A description of the types of services to be provided, and the areas to be served, including a description of the transmission characteristics and performance objectives for each type of proposed service, details of the link noise budget, typical or baseline earth station parameters, modulation parameters, and overall link performance analysis (including an analysis of the effects of each contributing noise and interference source);**

The AMAZONAS-1 satellite will be used for digital communications services, including video and internet applications, with bit rates ranging from 64 Kbit/s, possibly less, to 1 Gbit/s.

The AMAZONAS-1 satellite serves from the North of USA to the South of Argentina and Europe.

The files called *LINK_BUDGET_1.pfd* to *LINK_BUDGET_5.pfd* contain several examples of link noise budgets.

- (5) Calculation of power flux density levels within each coverage area and of the energy dispersal, if any, needed for compliance with §25.208; Calculation of power flux density levels within each coverage area and of the energy dispersal, if any, needed for compliance with §25.208, for angles of arrival other than 5°, 10°, 15°, 20°, and 25° above the horizontal.**

In all the Ku downlink frequency range, the power flux density at the Earth's surface produced by emissions from a space station for all conditions and for all methods will not exceed -132.5 dBW/m^2 1 MHz over the US territory and all the Americas:

$$-60.4 \text{ dBW/Hz max psd} + 29.9 \text{ (max gain dBi)} - 162 \text{ spreading losses (dB) (worst case).}$$

- (6) Public interest considerations in support of grant;**

The AMAZONAS-1 satellite will ensure digital transmission services between the United States, South America and Europe at the 36° W longitude orbital location.

The entry of the AMAZONAS-1 satellite into the market to meet US customers' demand for such services will enhance competition in that market. Accordingly, the grant of this application is in the public interest.

- (7) Applications for authorizations for fixed-satellite space stations shall also include the information specified in §25.140 (b)(1) and (2) of this part. Applicants for authorizations for space stations in the 17/24 GHz**

broadcasting-satellite service must also include the information specified in Sec. Sec. 25.140(b)(1) and (3) of this part.

There are no operational satellites that operate two-degrees away from 36° W.L. and which use the same frequency bands as the AMAZONAS-1 satellite. In fact, the two immediately adjacent operational satellites are the TELSAT-11N at 37.5° W.L. and the INTELSAT 903 at 34.5° W.L., both 1.5 degrees away from 36°W.L. Moreover, the INTELSAT 903 at 34.5° W.L. is not operating in the 11.7-12.2 GHz band. HISPASAT will operate all the traffic on AMAZONAS-1 following the coordination agreements to ensure unacceptable interference will not occur between them.

Nonetheless, a demonstration that the AMAZONAS-1 satellite network is two-degrees compatible is shown below. The results of the two-degree interference analysis assumes a satellite, operated at 38° W.L. or 34° W.L., having transmission parameters similar to those of AMAZONAS-1 (see Table 1). Table 2 provides a summary of the overall link C/I margins using the transmissions of AMAZONAS-1 as both the wanted and interfering carriers.

The interference calculations assumed a 1dB advantage for topocentric-to-geocentric conversion, all wanted and interfering transmission are co-polarized and all earth station antennas conform to a sidelobe pattern of 29-25 log (theta).

	Design. Emission	Mod. Type	Diam TX (m)	TX Ant. Gain (dBi)	Diam RX (m)	RX Ant. Gain (dBi)	U/L Power (dBW)	U/L Power Dens. (dBW/Hz)	D/L EIRP (dBW)	D/L EIRP Dens. (dBW/Hz)	C/N Req. (dB)	C/I Criterion (dB)
Wanted Carrier	14K0G7W	QPSK	1.2	43	2.9	49.7	-8	-49.5	5.6	-35.9	6.8	19
	14K0G7W	QPSK	2.4	49.2	1.7	44.9	-9.4	-50.9	10.4	-31.1	6.8	19
	1M80G7W	QPSK	3.7	53	2.6	48.7	9.5	-53.1	32.1	-30.5	9	17.7
	9M00G7W	8-PSK	3.7	53	2.6	48.7	15.1	-54.4	37.7	-31.8	8	20.2
	36M0G7W	QPSK	3.7	53	1.7	44.9	23	-52.6	45.1	-30.5	6.1	18.3

Table 1.- Assumed Ku-band transmission parameters of an adjacent satellite.

DESIGN EMISSION		Interfering carrier				
		14K0G7W	14K0G7W	1M80G7W	9M00G7W	36M0G7W
Wanted carrier	14K0G7W	2.7	4.4	4.6	6.0	4.5
	14K0G7W	1.5	4.1	4.5	5.9	4.4
	1M80G7W	22.2	27.9	9.2	10.5	9.0
	9M00G7W	25.3	31.0	12.3	6.7	5.1
	36M0G7W	34.8	38.7	18.6	13.0	5.5

Table 2.- Summary of the overall link C/I margins (dB)

It can be seen in Table 2 that all C/I margins are positive.

- (8) **Applications for authorizations in the Mobile-Satellite Service in the 1545–1559/1646.5–1660.5 MHz frequency bands shall also provide all information necessary to comply with the policies and procedures set forth in Rules and Policies Pertaining to the Use of Radio Frequencies in a Land Mobile Satellite Service, 2 FCC Rcd 485 (1987) (Available at address in §0.445 of this chapter.);**

N/A

- (9) Applications to license multiple space station systems in the non-voice, non-geostationary mobile-satellite service under blanket operating authority shall also provide all information specified in §25.142; and

N/A

- (10) Applications for authorizations in the 1.6/2.4 GHz Mobile-Satellite Service shall also provide all information specified in §25.143.

N/A

- (11) In addition to a statement of whether the space station is to be operated on a common carrier basis, or whether non-common carrier transactions are proposed, as specified in paragraph (c)(11) of this section, satellite applications in the Direct Broadcast Satellite service must provide a clear and detailed statement of whether the space station is to be operated on a broadcast or non-broadcast basis.

N/A

- (12) Applications for authorizations in the non-geostationary satellite orbit fixed-satellite service (NGSO FSS) in the bands 10.7 GHz to 14.5 GHz shall also provide all information specified in §25.146.

N/A

- (13) For satellite applications in the Direct Broadcast Satellite service, if the proposed system's technical characteristics differ from those specified in the Appendix 30 BSS Plans, the Appendix 30A feeder link Plans, Annex 5 to Appendix 30 or Annex 3 to Appendix 30A, each applicant shall provide:

- (i) The information requested in Appendix 4 of the ITU's Radio Regulations. Further, applicants shall provide sufficient technical showing that the proposed system could operate satisfactorily if all assignments in the BSS and feeder link Plans were implemented.
- (ii) Analyses of the proposed system with respect to the limits in Annex 1 to Appendices 30 and 30A.

N/A

- (14) A description of the design and operational strategies that will be used to mitigate orbital debris including the following information:
- (i) A statement that the space station operator has assessed and limited the amount of debris released in a planned manner during normal operations, and has assessed and limited the probability of the space station becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal;

The spacecraft is designed such that no debris will be released during normal operations. As part of the daily routine operations, an analysis using a public catalogue of orbital objects is conducted to avoid any collision, preventing the spacecraft to become a source of debris.

- (ii) A statement that the space station operator has assessed and limited the probability of accidental explosions during and after completion of mission operations. This statement must include a demonstration that debris generation will not result from the conversion of energy sources on board the spacecraft into energy that fragments the spacecraft. Energy sources include chemical, pressure, and kinetic energy. This demonstration should address whether stored energy will be removed at the spacecraft's end of life, by depleting residual fuel and leaving all fuel line valves open, venting any pressurized system, leaving all batteries in a permanent discharge state, and removing any remaining source of stored energy, or through other equivalent procedures specifically disclosed in the application;**

HISPASAT has assessed and limited the probability of accidental explosions during and after completion of mission operations. The spacecraft is designed in manner to minimize the potential for such explosions. Propellant tanks and thrusters are isolated using redundant valves and electrical power systems are shielded in accordance with standard industry practices. At the completion of the mission, and upon disposal of the spacecraft, HISPASAT will ensure the removal of all stored energy on the spacecraft by leaving open all propellant line valves located downstream the propellant tanks to deplete all propellant tanks, venting pressurized systems, turning off all active units and activating the battery bypass to avoid recharging.

- (iii) A statement that the space station operator has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations. Where a space station will be launched into a low-Earth orbit that is identical, or very similar, to an orbit used by other space stations, the statement must include an analysis of the potential risk of collision and a description of what measures the space station operator plans to take to avoid in-orbit collisions. If the space station operator is relying on coordination with another system, the statement must indicate what steps have been taken to contact, and ascertain the likelihood of successful coordination of physical operations with, the other system. The statement must disclose the accuracy--if any--with which orbital parameters of non-geostationary satellite orbit space stations will be maintained, including apogee, perigee, inclination, and the right ascension of the ascending node(s). In the event that a system is not able to maintain orbital tolerances, i.e., it lacks a propulsion system for orbital maintenance, that fact should be included in the debris mitigation disclosure. Such systems must also indicate the anticipated evolution over time of the orbit of the proposed satellite or satellites. Where a space station requests the assignment of a geostationary-Earth orbit location, it must assess whether there are any known satellites located at, or reasonably expected to be located at, the requested orbital location, or assigned in the vicinity**

of that location, such that the station keeping volumes of the respective satellites might overlap. If so, the statement must include a statement as to the identities of those parties and the measures that will be taken to prevent collisions;

HISPASAT has assessed and limited the probability of the space station becoming a source of debris as a result of collisions with large debris or other operational space stations. As part of the daily routine operations, an analysis using a public catalogue of orbital objects is conducted to avoid any collision, preventing the spacecraft to become a source of debris.

The proposed orbital location for AMAZONAS-1 is 36° W.L.. AMAZONAS-1 will be maintained on the geostationary orbit within a window of less than $\pm 0.07^\circ$ in North-South and less than $\pm 0.05^\circ$ East-West. Initially it will not be HISPASAT co-located satellites. The co-location strategy, if applicable at a later stage, will be coordinated for all the satellites in the cluster and will be based on separation in eccentricity and inclination method assuring no collisions between the satellites.

- (iv) A statement detailing the post-mission disposal plans for the space station at end of life, including the quantity of fuel--if any--that will be reserved for post-mission disposal maneuvers. For geostationary-Earth orbit space stations, the statement must disclose the altitude selected for a post-mission disposal orbit and the calculations that are used in deriving the disposal altitude. The statement must also include a casualty risk assessment if planned post-mission disposal involves atmospheric re-entry of the space station. In general, an assessment should include an estimate as to whether portions of the spacecraft will survive re-entry and reach the surface of the Earth, as well as an estimate of the resulting probability of human casualty.**

At the end of the mission, HISPASAT will dispose of the spacecraft by moving it to a minimum altitude of 415 kilometers above the geostationary arc. This exceeds the minimum altitude established by the IADC formula.

HISPASAT has reserved 18.35 kilograms of fuel for this purpose. This fuel figure was determined by the spacecraft manufacturer and provided for in the propellant budget. To calculate this figure, the "rocket equation" was used, taking into account the expected mass of the satellite at the end of life and the required delta-velocity to achieve the desired orbit. The fuel gauging uncertainty has been taken into account in these calculations.

In calculating the disposal orbit, HISPASAT has used simplifying assumptions as permitted under the Commission's Orbital Debris Report and Order. For reference, this calculation results in a minimum perigee disposal altitude under the IADC formula of at most 281.7 kilometers above the geostationary arc, which is lower than the 415 kilometers above geostationary disposal altitude specified by HISPASAT.

The post-mission disposal orbital altitude is based on the following calculation according to section 25.283:

$$36,021 \text{ km} + (1000 \times C_R \times A / m)$$

where:

" $C_R \times A$ " = Solar Pressure Radiation Coefficient x Total Solar Pressure Area = 99 m²

"m" = Dry Mass of the Satellite = 2118.3 kg

then

$$\begin{aligned} &= 36,021 \text{ km} + (1000 \times C_R \times A / m) \\ &= 36,021 \text{ km} + 1000 \times 99 / 2341 \\ &= 36,067.7 \text{ km} \\ &= 281.7 \text{ km above GSO (35,786 km)} \end{aligned}$$

- (15) Each applicant for a space station license in the 17/24 GHz BSS shall include the following information as an attachment to its application:
- (i) Except as set forth in paragraph (d)(15)(ii) of this section, an applicant proposing to operate in the 17.3-17.7 GHz frequency band, must provide a demonstration that the proposed space station will comply with the power flux density limits set forth in Sec. 25.208(w) of this part.
 - (ii) In cases where the proposed space station will not comply with the power flux density limits set forth in Sec. 25.208(w) of this part, the applicant will be required to provide a certification that all potentially affected parties acknowledge and do not object to the use of the applicant's higher power flux densities. The affected parties with whom the applicant must coordinate are those GSO 17/24 GHz BSS satellite networks located up to 6 away for excesses of up to 3 dB above the power flux-density levels specified in Sec. 25.208(w) of this part, and up to 10 away greater for excesses greater than 3 dB above those levels.
 - (iii) In cases where the proposed 17/24 GHz BSS space station will be operated in the 17.3-17.7 GHz band, or operated to provide international service in the 17.7-17.8 GHz band, and cannot be located precisely at one of the nominal 17/24 GHz BSS orbital locations specified in Appendix F of the Report and Order, adopted May 2, 2007, IB Docket No. 06-123, FCC 07-76, the applicant must provide a demonstration that the proposed space station will not cause more interference to other 17/24 GHz BSS satellite networks operating in compliance with the rules for this service than if it were located at the precise 17/24 GHz BSS orbital location from which its proposed location is offset.
 - (iv) An applicant proposing to provide international service in the 17.7-17.8 GHz band must demonstrate that it will meet the power flux density limits set forth in Sec. 25.208(c) of this part.

N/A

- (16) In addition to the requirements of paragraph (d)(15) of this section, each applicant for a license to operate a 17/24 GHz BSS space station that will

be used to provide video programming directly to consumers in the United States, that will not meet the requirements of Sec. 25.225 of this part, must include as an attachment to its application a technical analysis demonstrating that providing video programming service to consumers in Alaska and Hawaii that is comparable to the video programming service provided to consumers in the 48 contiguous United States (CONUS) is not feasible as a technical matter or that, while technically feasible, such service would require so many compromises in satellite design and operation as to make it economically unreasonable.

N/A

ANNEX 1

KU BAND COPOLAR ANTENNA GAIN CONTOURS FOR THE NORTH AMERICA BEAM

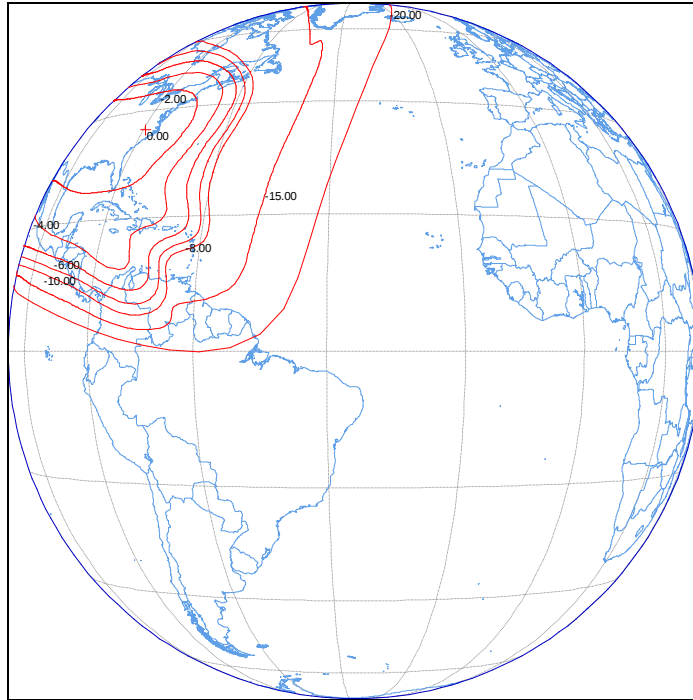


Figure-1: Antenna gain contours contained in *vupkunach.GXT* (NORTH AMERICA receive beam horizontal polarization, copolar).

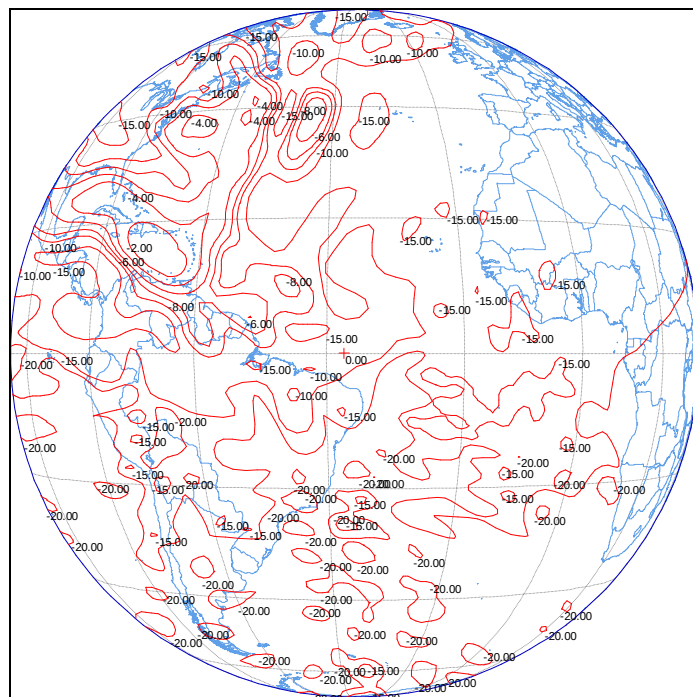


Figure-2: Antenna gain contours contained in *VUPKUNAXh.GXT* (NORTH AMERICA receive beam horizontal polarization, crosspolar).

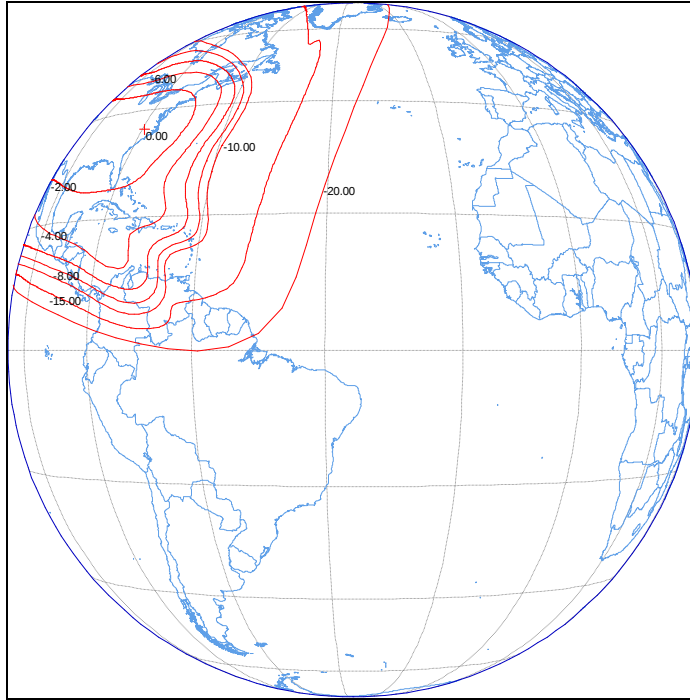


Figure-3: Antenna gain contours contained in *vupkunacv.GXT* (NORTH AMERICA receive beam vertical polarization, copolar).

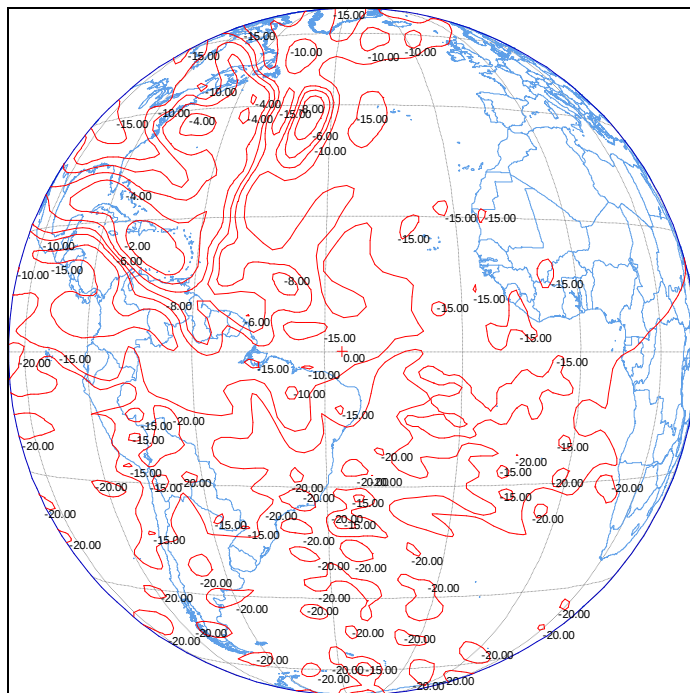


Figure-4: Antenna gain contours contained in *VUPKUNAXv.GXT* (NORTH AMERICA receive beam vertical polarization, crosspolar).

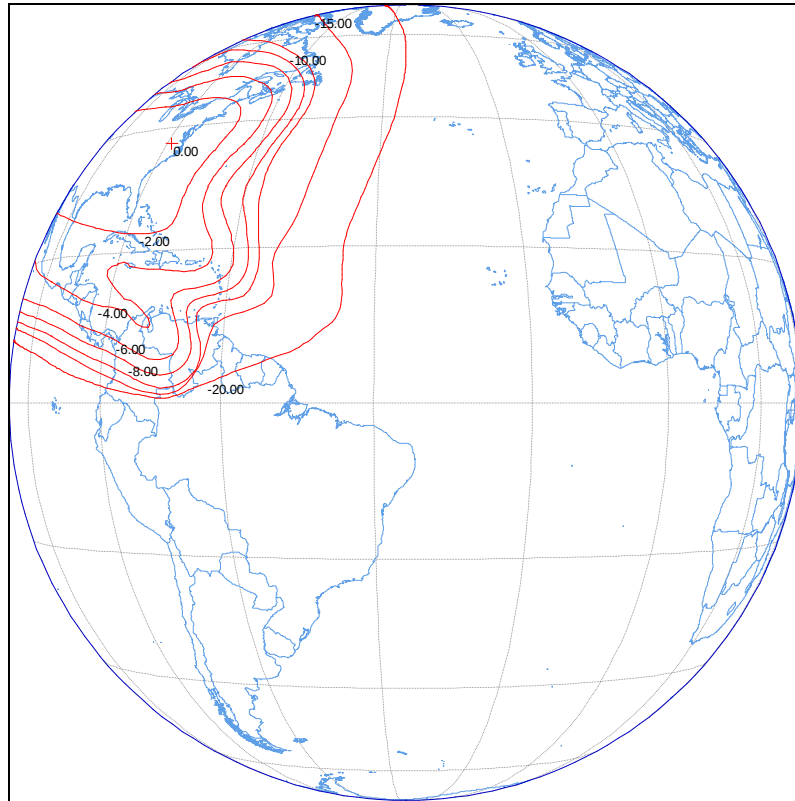


Figure-5: Antenna gain contours contained in *vdwkunach.GXT* (NORTH AMERICA transmit beam horizontal polarization, copolar).

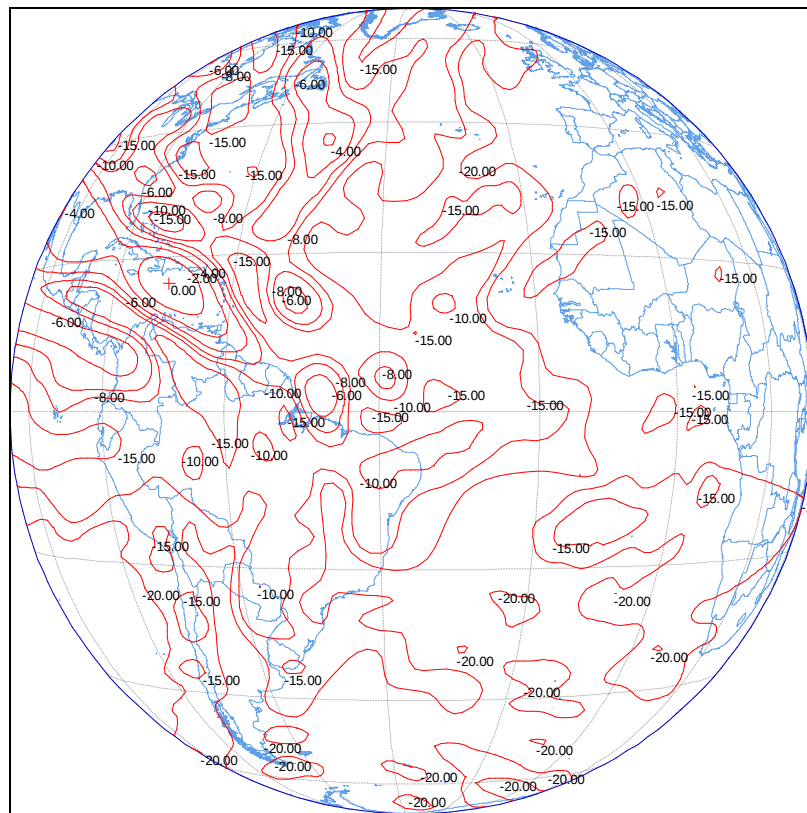


Figure-6: Antenna gain contours contained in *VDWKUNAXh.GXT* (NORTH AMERICA transmit beam horizontal polarization, crosspolar).

